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CLUTCH COMPRISING A SPRING DEVICE AND METHOD FOR OPERATING SAME

This invention relates to a clutch according the preamble of Patent Claim 1 and a method for operating such a clutch.

Operation of a generic clutch is influenced by the properties of the spring mechanism, among other things. The spring force produced by the spring mechanism can vary due to the manufacturing or can be varied as a function of operating time.

A power-shift transmission such as an infinitely variable, automatic power-shift transmission for vehicles having a generic clutch is known from German Patent DE 198 22 193 A1, which is a hydrodynamically operated multi-disk clutch. The closing force of this clutch is generated by a hydraulic cylinder which actuates a piston acting on the clutch disks against the force of a plate spring. The opening force is applied by the plate spring as a spring device of this clutch. The opening of the clutch, which is produced by the plate spring, must occur during an accurately predetermined period of time, i.e., within a certain time window, for optimum functioning of the shift transmission. To this end, the hydraulic pressure within the hydraulic cylinder, which is responsible for the closing of the clutch, is monitored by pressure sensors and used as control and/or regulating variables for the operation of the clutch. The measured values obtained by the pressure sensors depend on the temperature, among other things, due to the change in viscosity of the hydraulic fluid.

This invention relates to the problem of permitting opening and/or closing of the clutch with the greatest possible time precision in a generic clutch. Changes that may result

from a change in the properties of the spring mechanism should also be reliably avoided.

This problem is solved with a generic disk clutch by a design according to the characterizing features of Patent Claim 1.

Advantageous and expedient embodiments of this device are the object of the dependent Claims 2 through 4.

An advantageous method of operating an inventive clutch is the object of Claim 5.

In a spring device consisting of at least one plate spring or together with a shaft spring, also known as an ondular washer, the sensor is advantageously mounted directly on the at least one plate spring and/or shaft spring in an area not adjacent to a thrust bearing. It is of course also possible to provide the sensor on a particular thrust bearing of the spring mechanism.

When using plate springs and/or shaft springs, it is especially advantageous to provide as the sensor a piezoresistive amorphous carbon layer (e.g., DLC (diamond-like carbon) layer) applied permanently to a surface area not in direct contact with a thrust bearing. The carbon layer must have a thickness of only 10 nm to 500 µm, preferably 10 nm to 20 µm. Such layers, which may be applied by a PVD (physical vapor deposition) method or a CVD (chemical vapor deposition) method and are used to produce sensors for determining the state of characteristics of mechanical components, are described in German Patent DE 199 54 164 A1. Washers provided with measurement layers are known from German Patent DE 198 31 372 A1 for monitoring non-positive connections.

An inventive method for operating a generic shift transmission consists of controlling and/or regulating an adjusting force acting on the clutch by means of characteristic values of the spring mechanism determined as current values by the sensor and/or its at least one thrust bearing.

The transfer of the measured values detected by the sensor may be transmitted in an especially advantageous manner via a telemetric signal pickup. The high measurement sensitivity of the inventive sensors is especially suitable for a telemetric signal analysis. With respect to the principle of telemetric signal analyzing methods applicable here, reference is made in the state of the art to German Patent DE 40 34 019 C1, European Patent 0 533 709 B1 and German Patent DE 37 14 195 A1, for example.

An advantageous exemplary embodiment to be explained in greater detail below is depicted in the drawing.

In this drawing, the only figure shows:

Figure 1 a half section through a schematic diagram of a multi-disk clutch of a manual transmission according to German Patent DE 198 22 193 A1.

A first body 1 and a second body 2, each rotatably mounted, are interconnectable in a non-positive manner by means of intermeshing disks.

A pressure valve 5 is mounted on the second body 2 in a rotationally fixed but axially displaceable manner. With this pressure valve 5, the disks of the two bodies 1, 2 can be pressed together in a non-positive manner for engaging the clutch.

To disengage the clutch, a plate spring serves as the spring mechanism 3 by means of which the pressure valve 5 is shifted to achieve an opened state of the clutch. A hydraulic pressure (not depicted in the drawing) acts on the pressure valve 5 to engage the clutch, namely acting against the force of the plate spring 3. The pressure valve 5 determines the duration of the opening of the clutch under the force of the plate spring 3.

The plate spring 3 is provided with a DLC layer as the sensor 4. The measured values obtained by the sensor 4, similar to the current spring force of the plate spring 3, are preferably sent telemetrically to an electronic analyzer unit, from which the measured values can be utilized to control and/or regulate the adjusting force acting on the clutch. The deceleration force of the hydraulic pressure applied to the pressure valve 5 counteracting the opening of the clutch should be part of the aforementioned actuating force and/or adjusting force acting on the clutch in the sense of the description of the present invention.

In the electronic analyzer unit, the actual measured values measured by the sensor 4 can be modified to take into account the properties of the physical state influencing these measured values in or on the spring mechanism.